

Running head: RESTORATIVE SETTINGS FOR STUDY BREAKS

Where to take a study break on the college campus:

An attention restoration theory perspective

Abstract

College students spend much of their time on campus engaged in activities that require sustained directed attention, which may lead to attention fatigue. They would benefit from campus settings that provide effective restoration breaks and allow them to return to their work cognitively refreshed. Studies have found direct exposure to nature, viewing nature through windows, and viewing images of nature are restorative. In the present study, college students, instructed to imagine themselves cognitively fatigued, rated the perceived restorativeness of indoor campus settings that varied by view of nature: some had no views of nature, some had window views of nature with built structures present, and some had views of simulated nature depicted as large nature murals. Students rated settings with views of dramatic nature murals, especially those with water, more restorative than settings with window views of real, but mundane nature with built structures present. Students rated settings that lacked views of real or simulated nature least restorative. The findings suggest that large nature murals in indoor settings used for study breaks may provide attentionally fatigued students with opportunities for restoration when views of nature are unavailable or limited in restorative potential.

1. Introduction

According to attention restoration theory (ART), directed attention is voluntary, central to maintaining focus, controls distractions through inhibitory mechanisms, and requires effort (Kaplan, 1995; Kaplan & Kaplan, 1989). It is vulnerable to fatigue and becomes less effective with sustained use, leading to reduced ability to focus attention, increased performance errors, and heightened irritability. When directed attention fatigue occurs in response to intense and sustained mental effort, individuals experience a condition commonly referred to as mental fatigue. University students spend a great deal of time studying, reading course material, completing problem sets or other homework, working on reports and projects, preparing presentations, taking exams, and engaging in other activities that require sustained directed attention. As a result, college students may frequently experience mental fatigue (Kaplan, 1995; Tennessen & Cimprich, 1995) and the effects of that fatigue may reduce the efficacy of their scholarly efforts and lead to lower academic achievement.

ART also prescribes conditions that promote recovery from mental fatigue; these are found in restorative settings that have four properties. These properties of being away, extent, fascination, and compatibility are well described by Kaplan (1995) and Herzog, Maguire, and Nebel (2003). *Being away* involves distancing oneself from the usual activities that lead to attention fatigue. Being away can be physical, such as leaving the office to walk in a park or taking a seaside vacation; however, to be effective it need not involve a change in location, but must involve a change in mental content from that which led to fatigue to something quite

different. *Extent* exists in an environment that has sufficiently rich content and coherent structure to be perceived as a “whole other world” (Kaplan, 1995, p.173) and provide enough to see and think about to fully engage the mind. *Fascination* is involuntary attention, which does not require effort or inhibition of competing stimuli and allows a fatigued attentional system to rest, restoring the capacity of directed attention. It occurs in a variety of settings and situations that people find interesting and varies in intensity along what Kaplan (1995) referred to as a ‘soft-hard’ dimension. Soft fascination, which is moderate in intensity and generally focused on aesthetically pleasing stimuli, permits an opportunity for reflection that best promotes attention restoration. Soft fascination is common in natural settings (Herzog, Black, Fountaine, & Knotts, 1997); for example, viewing a colorful sunset is likely to evoke soft fascination. Hard fascination rivets one’s attention and generally does not allow reflection. Viewing a very competitive sporting event is likely to produce hard fascination. *Compatibility* occurs when the setting fits what the individual is trying to achieve; the individual’s goals must be consistent with demands made by the setting and the environment must provide the information needed by the individual to achieve those goals.

A growing body of research has found that natural settings are especially effective for promoting attention restoration. Hartig, Mang, and Evans (1991) compared proofreading performance in three groups of experienced backpackers who had completed either a wilderness vacation, an urban vacation, or continued their normal work with no vacation. Only the wilderness group had improved scores in a pre-post design. The authors also reported results of an experiment

with random assignment that revealed better recovery from cognitive fatigue, also assessed with a proofreading task, among college students who took a walk in a park compared to those who took a walk in a well-kept urban setting or relaxed in a comfortable indoor setting. Other studies found beneficial effects of exposure to nature in more vulnerable groups. For example, Cimprich (1993) studied treatments for attention deficits commonly found in women after surgery for breast cancer and found interventions that included activities involving nature, such as gardening, led to improved attention, while the control condition, lacking exposure to nature, produced no improvement. Directed attention was assessed with total scores from a battery of tasks that required inhibition of competing or distracting stimuli, including the digit scan forward, digit scan backward, symbol digit modalities, letter cancellation, and Necker cube pattern control tests. Wells (2000) found that children who had the largest increase in exposure to nature after moving from poor housing to better housing had the greatest improvement in directed attention, assessed with mothers' ratings of children's functioning using the Attention Deficit Disorders Evaluation Scale (McCarney, 1995).

Other researchers reported that viewing nature through windows fostered attention restoration. Tennessen and Cimprich (1995) found college students who had views of only natural elements through their dormitory windows performed better on tests of directed attention (symbol digit modality test and Necker cube pattern control test) than students who had views that were partly natural or entirely built. Kaplan (2001) found apartment residents with views of nature from their windows felt more effective, more relaxed, and less distracted than residents

with no views of nature. These authors suggested that residents with window views of nature had opportunities for restorative experiences (through indirect contact with nature) that were not available to residents without such views.

Viewing simulated nature (i.e., images of nature in paintings, photographs, slides, videos, computer displays) was also found to be restorative. Berto (2005) tested attentional capacity in college students before and after they viewed computer-displayed photographs of settings that others previously judged to be restorative (nature scenes) or nonrestorative (non-nature scenes); she found improvement only in students who viewed the nature scenes.

Recently, Ziesenitz and Krömker (2008) compared attention restoration, using the Necker cube pattern control test, and stress recovery, assessed with salivary alpha-amylase, between participants who walked through a park or watched a video recording or a computer simulation of the same walk through the park, and found no differences between the groups. In contrast, Kahn et al. (2008) found heart rate recovery from low level stress was greater in participants who viewed nature through a window than for those who viewed the same nature scenes on a plasma screen of equal size. This study did not assess attention restoration.

The studies cited in the previous paragraphs found natural environments were associated with greater attention restoration than built or urban settings in diverse samples and that restoration resulted from contact with nature, viewing nature through windows, or viewing images of nature. There is currently evidence from one study that suggests that direct exposure to nature and viewing simulated nature can be equally restorative.

Studies based on ART have also investigated the perceived restorativeness of natural and built environments, usually by employing rating scales to assess the four components of restorativeness. Natural settings were generally rated higher than built and urban environments and these results have held for both real and simulated environments. Hartig, Korpela, Evans, and Gärling (1997) found university students rated natural environments higher than built environments in restorative properties. They also found no differences in ratings between subjects who walked through a forest and subjects who viewed a video of a walk through a forest, or between students in Sweden, Finland, or the United States. Laumann, Gärling, and Stormark (2001) found college students rated natural environments more restorative than urban settings whether students imagined themselves in or viewed videos of the environments. One study found students rated pictures of urban settings with prominent green space more restorative than urban settings without green space, but less restorative than natural settings without built structures (Herzog et al., 2003). Purcell, Peron, and Berto (2001) found students provided higher ratings of perceived restorativeness for images of nature scenes than images of urban scenes, and provided the highest ratings for nature scenes that contained water.

Some researchers investigated the effects of imagined or real attentional fatigue on perceived restorativeness of environments depicted in slides. Herzog et al. (1997) reported that college students who imagined themselves attentionally fatigued rated nature settings more restorative than sports or entertainment settings, which they rated more restorative than urban settings. Students who

viewed slides of a walk through a forest and a walk through a city rated “expectation of recovery” from fatigue higher in the forest, and students who had first imagined themselves fatigued rated recovery more positively than those who had imagined themselves refreshed (Staats, Kieviet, & Hartig, 2003). In a follow-up study that varied actual attentional fatigue, students again expected greater recovery in the forest than the urban setting, and students who were mentally fatigued after an afternoon lecture provided greater likelihood of recovery ratings for the forest setting and lower likelihood of recovery ratings for the urban setting than students who were less mentally fatigued before a morning lecture (Hartig & Staats, 2006).

Collectively, work on attention restoration has determined (1) that ratings of the four components of restorativeness described by attention restoration theory (which combined provide a measure of perceived restorativeness) are higher for natural than built or urban settings, whether the settings are directly experienced, imagined, or viewed in pictures; (2) that expectations for attentional recovery are greater for natural than built or urban settings when the settings are viewed in pictures; (3) that the expectations for recovery in natural settings (viewed in pictures) are enhanced when individuals are, or imagine themselves to be, attentionally fatigued; and (4) that natural settings actually are more restorative than built and urban settings, whether the settings are experienced directly, viewed through windows, or viewed in pictures.

Important for research design, these findings suggest that settings perceived to be restorative are typically found to be restorative, and simulations of settings

(pictures, slides, computer screen images, and videos) may be useful for evaluating perceived restorativeness. However, it is important to exercise caution in applying these findings, as only one study tested and found no differences in perceived restorativeness between real and simulated environments (Hartig et al., 1997), and one study tested and found actual restoration to be equal between direct exposure to and simulated views of nature (Ziesenitz & Krömker, 2008).

1.1 The present study

Because many activities that lead to mental fatigue in college students occur on campus, it would benefit students if there were campus settings that provided restoration breaks and allowed them to return to their work cognitively refreshed. Although many colleges have considerable amounts of green space, affording both direct access to and views of nature, there is considerable variation between campuses in access to, amount of, and restorative qualities of outdoor settings. Even on campuses with green space, many buildings are large and have interior spaces with limited or no views of outdoors. Furthermore, restorative properties of nature can change with the seasons. For example, in northern climates, during the winter, cold weather may limit access to nature, flowers are absent, grass may be brown, and trees lack leaves to block views of buildings and parking lots. Students are less likely to spend time outdoors while on campus during this period and contact with and views of outdoors may be less restorative than during warmer months. Consistent with this claim, a study in Sweden found that cold summer temperatures limited access to restorative experiences in nature and were associated with increased indices of depression (Hartig, Catalano, & Ong, 2007).

Given the concerns described above, the present study evaluated students' perceptions of the restorativeness of *indoor* campus settings with window views of the types of mundane campus scenes available during much of the academic year, and compared those to the perceived restorativeness of similar settings with no views of nature or with views of dramatic and aesthetically pleasing, simulated nature in the form of wall-sized murals. Large murals of nature scenes were used because studies cited above found viewing images of nature promoted attention restoration and because large images of nature led to greater psychophysiological stress recovery than small images, presumably through a greater sense of immersion in the environment (deKort, Meijnders, Sponselee, & IJsselstein, 2006). Other studies found people working in offices without windows often placed images of nature, including murals, in their offices (Heerwagen & Orians, 1986), and that the use of nature scenes (including murals) in medical facilities led to reduced pain in patients (Diette, Lechtzin, Haponik, Devrotes, & Rubin, 2003; Miller, Hickman, & Lemasters, 1992) and lower physiological and affective indices of stress in people awaiting dental treatments (Heerwagen, 1990) or surgery (Coss, 1990 as cited in Nanda, Eisen, & Baladandayuthapani, 2008). Although these studies investigated the influences of nature scenes on pain relief and stress recovery rather than on attention restoration, one of the explanations for the benefits of nature focused on the four components of restorative environments described by attention restoration theory (Nanda et al., 2008).

Settings used in this study varied by view into four categories: (1) no views of nature (no windows or window views of only built structures); (2) window views

of late fall nature with leafless trees and some built structures visible; (3) views of wall-sized murals of fields and forests or trees with colorful leaves; and (4) views of wall-sized murals of a seacoast or waterfall, each with some vegetation. Two categories of murals were used because an earlier study found nature scenes with water were perceived to be more restorative than nature scenes without water (Purcell et al., 2001). Students rated the perceived restorativeness of each setting using one item for each component of restorativeness and one item for overall perceived restorativeness. The study differed from earlier work in two ways, first by assessing influences of views of nature on perceived restorativeness of indoor settings, and second, by comparing views of real nature (seen through windows) and simulated nature (murals) in the same study.

The hypotheses of the study were based on attention restoration theory and results of studies that evaluated actual and perceived restoration of natural and built settings. I hypothesized that students would provide low ratings of perceived restorativeness for settings with no views of real or simulated nature (category 1). These settings had views of indoor and outdoor walls that were not likely to foster a sense of distance from one's usual activities (being away); they lacked rich content to engage the mind (extent) or interesting features to evoke effortless attention (fascination). However, the settings were typically used for relaxation and socializing and might be perceived as comfortable and suitable for taking a break from academic work (compatibility).

For settings with window views of nature with built structures (category 2), I hypothesized, based on earlier work (Herzog et al., 2003; Tennessen & Cimprich,

1995), that students would provide higher ratings on all components of perceived restorativeness for settings with the most expansive views of nature and the least prominent built structures. Also, while studies of the restorative properties of mundane nature with leafless trees have not been reported, Kaufman and Lohr (2004) found that people had more positive emotional responses to trees with foliage colors that suggested better health. Based on this, I expected views of leafless trees to be perceived as somewhat less restorative. Because all of the settings in this category had views with leafless trees and some built structures, I hypothesized that students would rate these settings only moderately restorative.

I hypothesized that students would provide ratings of high perceived restorativeness for settings with views of wall-sized nature murals (categories 3 and 4). Large images of nature with rich content and coherent structure would likely evoke a sense of immersion in the environments and increase perceptions of *being away* and *extent* (deKort et al., 2006). The content of the murals, featuring interesting and aesthetically pleasing natural vistas of types often cited by people as preferred places for restoration (Purcell et al., 2001; Ulrich, 1993), would likely produce *soft fascination* (Herzog et al., 1997) and *compatibility*. Finally, based on earlier work (Purcell et al., 2001), I hypothesized that students would rate murals with prominent water elements more restorative than murals without water.

2. Method

2.1. Participants

Participants were students enrolled in psychology courses at a small, suburban campus ($n = 99$) or a large, urban campus ($n = 137$) of the same university in the

Midwestern United States. Students included 172 women and 64 men (mean age = 23.2 years, $SD = 6.6$ years). Because students from the small campus (where settings for environmental stimuli were photographed) may have been familiar with the settings, students from the urban campus, who were unfamiliar with the settings, served as a control group for familiarity. All students earned credit for research participation in psychology courses.

2.2. *Environmental stimuli*

Settings used to evaluate perceived restorativeness included areas on the small campus often used for relaxation or socializing, including lounges and a café. The settings were classified into the four categories of view described above and each category included five images. Settings in the first two categories (no views of nature and window views of nature) represented views common on campus and were created from digital photographs of campus locations. Views of outdoor nature were actual scenes through windows and included unremarkable late fall scenery with flat fields of grass, scattered, leafless trees, and varying presence of built structures. Outdoor views without visible built structures were not available in late fall. The two categories with views of nature murals (with or without water features) depicted settings not available on campus, but created from photographs of campus settings using digital editing techniques. Briefly, walls or windows in the background were digitally erased and replaced with images of dramatic nature scenes, creating photographs of settings that appeared to have wall-sized murals in the background. Such editing permitted comparisons between interior settings that varied in view of nature, but were otherwise identical or similar.

Figures 1-4 provide two examples of each category. Figure 1 shows a setting with a solid wall and a similar setting with a window view of only a nearby brick wall. Figure 2 shows a setting with green space and a large, nearby building and a similar setting with more expansive green space and less imposing, distant built structures. Figure 3 shows a setting with a wall-sized nature mural of bright fall foliage and a setting with a mural of rolling hills and forests. Figure 4 shows two different settings with murals, one featuring an ocean meeting a coastline and the other showing a waterfall amid vegetation. Note that some settings (e.g., Figure 2a and Figure 3b) were identical except for view. Students also rated the same setting with a solid wall instead of a window and with a mural of a waterfall.

In addition to rating the perceived restorativeness of these four groups of settings, students rated eight settings that were not expected to be perceived as restorative, including classrooms and work areas. These settings represent campus areas in which students spend much of their time engaged in academic work, and are likely to be the settings in which the students become cognitively fatigued. As such, they should provide appropriate context in which to judge the perceived restorativeness of campus settings that might be used for attention restoration. Because view was not varied in these settings, they were analyzed separately from the four groups of settings in which view was varied, and their perceived restorativeness scores were used only to test whether students did, in fact, rate them low in restorative potential. These settings were intermixed with those in the four categories of view of nature during presentation. To reduce consideration of interpersonal issues while students rated settings, images did not include people.

2.3. Measures

Because there were numerous settings to evaluate, students rated perceived restorativeness using one item for each of its four components, modified from the single-item scales of Herzog et al. (2003) and Berto (2005). Students rated all items using a 7-point Likert scale anchored at “1 = Not at all” and “7 = Very Much.” The item for *being away* was “Some settings allow you to feel like you are far away from everyday thoughts and concerns. How much does this setting allow you to get away from it all, relax, and think about what interests you?” The item for *extent* was “Some settings, large or small, can feel like a whole world of their own, where you can get completely involved in the setting and not think about anything else. How much does this setting feel like a world of its own?” The item for *fascination* was “How much does this setting draw your attention without effort and easily engage your interest?” and the item for *compatibility* was “How much does this settings make you feel comfortable and at ease?” An additional item assessed overall perceived restorativeness, “Overall, how much do you agree that this setting would be excellent for taking a break and restoring your ability to study for an exam or work effectively on a demanding project?” This question was similar to the single-item measure of perceived restorative potential used by Herzog et al. (2003) that asked students to recall a time when sustained effort led to fatigue and then rate how good various settings would be to take a break and restore ability to work effectively on a project.

2.4. Procedure

Students completed the study online using computers connected to a website on the internet. The website provided the environmental stimuli and questions described above and required responses to be entered using computer keyboards. After students provided minimal demographic data, they viewed the following instructions, “We are interested in identifying settings that students feel would be the best places for taking a break after strenuous mental effort. Imagine that you have been studying for an exam or working on a class project for several hours. Even though you are not finished, you are mentally fatigued and need to take a break before continuing.” Students were instructed to consider the features of the settings, including the views present, and to answer all questions for each setting.

Images of the settings and the questions to be answered for each appeared on individual pages. The images were moderately high resolution and approximately 15.0 x 16.5 cm when viewed on a 35.6 cm diagonal computer screen. Questions appeared below the images and students could scroll up and down to look at each image as often as desired while responding to questions. Students could advance to the next page only after completing all questions for a setting. The last page thanked the students for participation, provided additional detail about the study, and listed several references for interested students.

3. Results

Each student’s score for *being away*, *extent*, *fascination*, and *compatibility* for each category of view was computed as the mean for all settings within that category. The mean of these means represented each student’s assessment of

perceived restorativeness for each category of view. This measure correlated strongly with the single-item measure of overall perceived restorativeness for settings with no view of nature, $r(234) = .88$, settings with windows views of nature with built structures, $r(234) = .89$, settings with views of nature murals without water, $r(234) = .88$, and settings with views of nature murals with water, $r(234) = .89$, all $ps < 0.001$. These findings suggest that the mean of the ratings of the components of restorativeness is a good measure of overall perceived restorativeness.

Mean ratings of the components of restorativeness for classrooms and work areas were $M = 2.43$ ($SD = 1.00$) for being away, $M = 2.52$ ($SD = 1.05$) for extent, $M = 2.38$ ($SD = 0.97$) for fascination, and $M = 2.46$ ($SD = 0.97$) for compatibility; the overall mean for perceived restorativeness was $M = 2.45$ ($SD = 0.96$). These findings confirmed that students perceived such settings to be low in restorative potential.

Repeated measures ANOVA was used to test the effects of view on ratings of the four components of restorativeness, and to test if familiarity with the settings influenced these ratings (by comparing ratings between students from the two campuses). View category was the repeated measures factor and student campus was the between subjects factor. Table 1 shows the means for being away, extent, fascination, and compatibility for the four categories of view. Also shown are the means for perceived restorativeness derived from these measures. Multivariate tests found the effects of category of view to be significant, $F(12, 223) = 77.78$, $p < 0.001$ (partial eta squared = 0.81), but neither student campus nor its interaction

with category of view had effects on ratings of the components of restorativeness, indicating that familiarity with settings did not affect perceived restorativeness.

Univariate tests, using Greenhouse-Geisser adjustments to degrees of freedom for calculating p -values, determined that category of view strongly influenced ratings for being away, $F(3, 702) = 366.21, p < 0.001$ (partial eta squared = 0.61), extent, $F(3, 702) = 396.28, p < 0.001$ (partial eta squared = 0.63), fascination, $F(3, 702) = 366.53, p < 0.001$ (partial eta squared = 0.61), and compatibility, $F(3, 702) = 322.65, p < 0.001$ (partial eta squared = 0.58). Planned contrasts, using the Bonferroni method, found that means differed between each category of view for each component of restorativeness, all $ps < 0.001$. Consistent with these findings, category of view also affected the measure of perceived restorativeness derived from component scores, $F(3, 702) = 409.52, p < 0.001$ (partial eta squared = .64). Again, neither student campus nor its interaction with category of view affected perceived restorativeness. Contrasts showed that means differed between all categories of view, all $ps < 0.001$.

The means shown in Table 1 correspond to perceived restorativeness ratings midway between low and moderate for settings with no views of nature, slightly above moderate for settings with window views of nature with built structures present, halfway between moderate and high for settings with nature murals without water, and high for settings with nature murals with water.

Although the effects of view on perceived restorativeness were tested by comparing groups of settings in different categories of view, these effects were especially evident when comparing individual settings that were identical except

for views of nature, which were varied using digital editing. For example, the setting depicted in Figure 3b is the same as that shown in Figure 2a, except a mural of rolling hills was digitally substituted for the window view of nature and support pole. Students also rated the same setting with a solid wall that provided no view of real or simulated nature, and with a mural of a waterfall (not shown). Mean ratings of perceived restorativeness for this setting were $M = 3.19$ ($SD = 1.29$) with no view, $M = 3.84$ ($SD = 1.37$) with a window view, $M = 4.43$ ($SD = 1.55$) with a view of a land mural, and $M = 5.05$ ($SD = 1.46$) with a view of a water mural.

Ratings for different settings within each category of view were very similar, with one exception. In the category of window views of green space, the setting with the least prominent built structures (Figure 2b) had a rating of 5.06 ($SD = 1.26$). This corresponded to a perceived restorativeness score that approached high and was midway between ratings for views of nature murals without water ($M = 4.76$, $SD = 1.21$) and nature murals with water ($M = 5.33$, $SD = 1.11$). In contrast, the mean rating for the other settings in that category, all of which had more conspicuous built structures, was 3.95 ($SD = 1.09$), which corresponded to a perceived restorativeness score of moderate.

4. Discussion

The purpose of this study was to evaluate how students who imagined themselves cognitively fatigued from sustained academic effort would perceive the restorative potential of indoor campus settings that varied by view of nature. The primary finding was that students perceived views of real or simulated nature

to be important to the restorative potential of indoor campus settings. They rated settings lacking these views between low and moderate in restorativeness, settings that had views of mundane, late fall nature with leafless trees and built structures present moderate, settings with nature murals without water between moderate and high, and settings with nature murals with water high in restorative potential. Although it is impossible to know how effective the instructions to imagine themselves mentally fatigued were, similar manipulations were used effectively in earlier studies (Herzog et al., 1997; Herzog et al., 2003; Staats et al., 2003).

Ratings for settings that had no views of nature were somewhat higher than expected, perhaps because these settings were generally used for relaxation or socializing and may have been perceived as compatible for restoration. Ratings for settings with views of mundane nature and built structures present were as predicted and most consistent with the finding that students rated urban settings with considerable green space intermediate in restorativeness between purely urban and purely natural settings (Herzog et al., 2003). As expected, students rated settings with views of dramatic, wall-sized nature murals far higher on the four components of restorativeness than settings with no views of green space, and more restorative than settings with window views that included green space with conspicuous built structures. In fact, only one setting with a window view of expansive green space and minimal built structures was comparable in perceived restorativeness to settings with views of murals. Students also rated settings with murals of waterfalls or panoramic ocean views more restorative than settings with murals that lacked water. This was consistent with the biophilia hypothesis

(Ulrich, 1993; Wilson 1984) and with results of an earlier study of perceived restorativeness (Purcell et al., 2001).

Although previous work (Kaplan, 2001; Tennessen & Cimprich, 1995) found that viewing nature through windows was restorative, the present results add to the literature by showing that the content of views through windows influenced the perceived restorativeness of the indoor settings from which those views originated. For example, settings that contained windows with views of flat fields and a few leafless trees retained restorative potential, and settings with window views of expansive green space and minimal built structures were perceived to be more restorative than settings with window views of less green space and more prominent built structures. Also novel was the finding that students perceived indoor settings with large nature murals to be high in restorative potential, and in fact, higher than settings with window views of real, but mundane nature. While it might appear a bias to compare window views of mundane nature scenes with views of dramatic nature murals, the goals of the study were to determine whether settings with the types of mundane nature views available to students during much of the academic year were perceived to be restorative, and to evaluate how dramatic nature murals, which could be provided in student lounges at any time, compared in perceived restorative potential. Importantly, these comparisons were made between settings that were similar or identical except for the views of real or simulated nature.

This study has important strengths, limitations, and implications. The use of college students and campus settings was ecologically appropriate, as the goal

was to identify influences of views of nature and simulated nature on college students' perceptions of the restorative potential of indoor settings on college campuses. An important limitation was that the study evaluated perceived restorativeness rather than actual restorativeness. Furthermore, while pictures of settings can be used to test perceived or actual restorativeness, it would be ideal, if feasible, to study actual restoration using actual settings, including settings with no views of nature, window views of nature, and views of large nature murals.

However, considering that the types of settings perceived to be restorative when viewed as images (Hartig & Staats, 2006; Herzog et al., 1997, 2003; Purcell et al., 2001; Staats et al., 2003) are similar to the types of settings found to be restorative when experienced directly (Cimprich, 1993; Hartig et al., 1991; Wells, 2000), viewed through windows (Kaplan, 2001; Tennessen & Cimprich, 1995), or viewed in pictures (Berto, 2005), it is reasonable to infer that the perception of restorative potential is a good predictor of actual restorativeness.

Several conclusions derive from this study. First, indoor settings with large nature murals may be able to provide restoration breaks from academic work for attentionally fatigued university students. If research determines that murals or other simulations (such as projected or backlit images) effectively foster restoration, universities could provide them in lounges and other settings where students seek restorative experiences. Second, because students perceived views of mundane late fall nature to retain restorative properties, especially when the presence of built structures was minimal, window views of green space should be provided whenever practical in campus settings used by students for recovery

from attentional fatigue. Third, campus administrators and landscape architects should consider enhancing the restorative features of campus green space when planning or renovating campus outdoor areas. Finally, nature murals should be used to supplement and not replace views of real green space; they would be most appropriately used in settings that lack restorative views of nature or during seasons when available views of nature are reduced in restorative potential. Universities should also educate students about the numerous health and psychological benefits associated with experiences with nature, including but not limited to attention restoration.

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Figure Captions

Figure 1. Examples of settings with no views of nature. (a) A lounge area with a solid wall. (b) A lounge area with a window view of a brick wall. Students rated these types of settings between low and moderate in restorative potential.

Figure 2. Examples of settings with window views of green space and varying presence of built structures. (a) A lounge area with a view of a field and a nearby, large building. (b) A lounge area with an expansive view of fields and distant built structures. Students rated these types of settings moderate in restorative potential.

Figure 3. Examples of settings with views of nature murals without water. (a) A café with a mural of nearby trees with bright fall foliage. (b) A lounge area with a mural of rolling hills and forests. Students rated these types of settings half way between moderate and high in restorative potential.

Figure 4. Examples of settings with views of nature murals with water. (a) A café with a mural of an ocean meeting a dramatic coastline. (b) A lounge area with a mural of a waterfall and vegetation. Students rated these types of settings high in restorative potential.